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THE IMPACT OF RING A ON LOCAL WATER WELLS

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Introduction

The prospect of siting the SSC in Northeastern Illinois has renewed an interest in local hydrogeology and is responsible for the State of Illinois Environmental Task Force. One goal of the Task Force is to scientifically integrate hydrogeologic information into a working model of the region and to predict the impact various ring sizes and orientations would have on water wells.

This report uses two methods to estimate the impact Ring A* could have on local water wells as a result of the migration of grout used to seal tunnel walls or the intersection of existing wells with the tunnel. First, a count is made of wells which intersect an "impact cylinder" defined by a surface annulus 250 ft on either side of the tunnel at a subsurface elevation of 400 ft MSL.† The Illinois State Water Survey (ISWS) records well coordinates to an accuracy of ±500 ft and therefore, the second method arrives at an estimate using the Monte Carlo technique and the assumption that the wells are homogeneously distributed.

Aquifer System

The Illinois study area includes all of Kane and parts of DuPage, DeKalb, and Kendall counties.[1] The bedrock topography extends in nearly horizontal, parallel planes throughout the region. The surface topography is flat, and the groundwater found in sand and gravel pockets of the glacial drift is

*Ring A is a pilot version of the SSC 71.97 miles in circumference.
†Mean Sea Level

nearly immobile. See Fig. 1 which shows the stratigraphic column of bedrock units in Northern Illinois.[2]

There are two aquifers which supply water to the area. The shallow body settles on top of the bedrock surface and collects in sand and gravel pockets dispersed throughout the glacial drift. This aquifer services both farm and domestic wells in the study area, and some community wells in the eastern region. The deeper aquifer, ~200 ft MSL, occurs in the St. Peter Sandstone just below the Galena Platteville Dolomite. Municipal and industrial water wells usually finish in this aquifer throughout the region.

Present considerations place the Ring at 400 ft MSL, well below the shallow aquifer. Therefore, a deep tunnel would have no impact on wells in the upper aquifer, but could impact some wells in the deeper aquifer. For example, during the excavation a deep well could be cut by a tunnel-boring machine. Furthermore, grout pumped into cracks of the tunnel to reduce the influx of water could temporarily cloud the water in nearby wells or cause permanent sealing. Experience in this region indicates that this could happen at distances up to 250 ft from the tunnel.[3,4]

The Impact of Ring A Based on Well Coordinates

The ISWS data represents 1156 separate water wells currently registered in the study area.[5] Each well has a description which includes stratigraphy, depth, location, static water level, pumping water level, specific capacity (gpm/ft.), and well use (i.e., farm, domestic, municipal, or industrial). The ISWS data generally has a coordinate uncertainty of ±500 ft. However, the uncertainty associated with some well locations may reach ±7467 ft. It is the author's conservative assumption that a well is impacted if 1) it extends down to 400 ft MSL, and 2) the uncertainty in well location coordinates would put it within 250 ft of the tunnel. The results of the count appear in Table I.

Table I. Summary of Well Data

Category	Number
Total number of wells in study area	1156
§Total number of wells with elevation < 470 ft MSL	564
Total number of wells with elevation < 400 ft MSL	446
Total number of wells possibly impacted	9

Impact for a Homogeneous Distribution

The number of impacted wells derived from the previous method relies on a particular ring geometry and orientation. The second estimate uses a Monte Carlo technique to "average" possible geometries and locations by assuming a uniform distribution of wells throughout the study area and then calculating the number most likely impacted. Therefore. . .

$$\text{Area (annulus)/Area (study site)} = \frac{\text{Number of impacted wells}}{\text{Number of wells deeper than 470 ft MSL}}$$

or,

$$\text{Number of impacted wells} = 564 \times (20.45 \text{ mi.}^2/1256 \text{ mi.}^2)$$

$$= 9 \text{ wells}$$

Summary

It is understood that the number of wells which will be impacted by a SSC project cannot be determined until a design and orientation is chosen for the study area. The two methods advanced here, however, indicate that the number is likely to be small.

§Since well depth is uncertain and decreases with time, a conservative estimate of depth for a well finished at 400 ft MSL is 470 ft MSL.

References

1. Kempton, J. P. et al., 1984, Siting the Superconducting Super Collider in Illinois, Department of Energy and Natural Resources.

2. Kempton, J. P., J. E. Bogner, and K. Cartwright, 1977, Geology for Planning in Northeastern Illinois, VIII. Regional Summary: unpublished maps and report on open file, prepared for the Northeastern Illinois Planning Commission by the Illinois Geological Survey.

3. Sasman, R., 1969, private communication.

4. McSwiggin, T. MSD-O'Hare Treatment Facility and Related Projects, 1976, Illinois Environmental Protection Agency, Division of Water Pollution Control.

5. Sasman, R. T. et al., Water-Level Trends, Pumpage, and Chemical Quality in the Cambrian-Ordovicain Aquifer in Illinois, 1971-1980, Illinois State Water Survey/Circular-154/82.

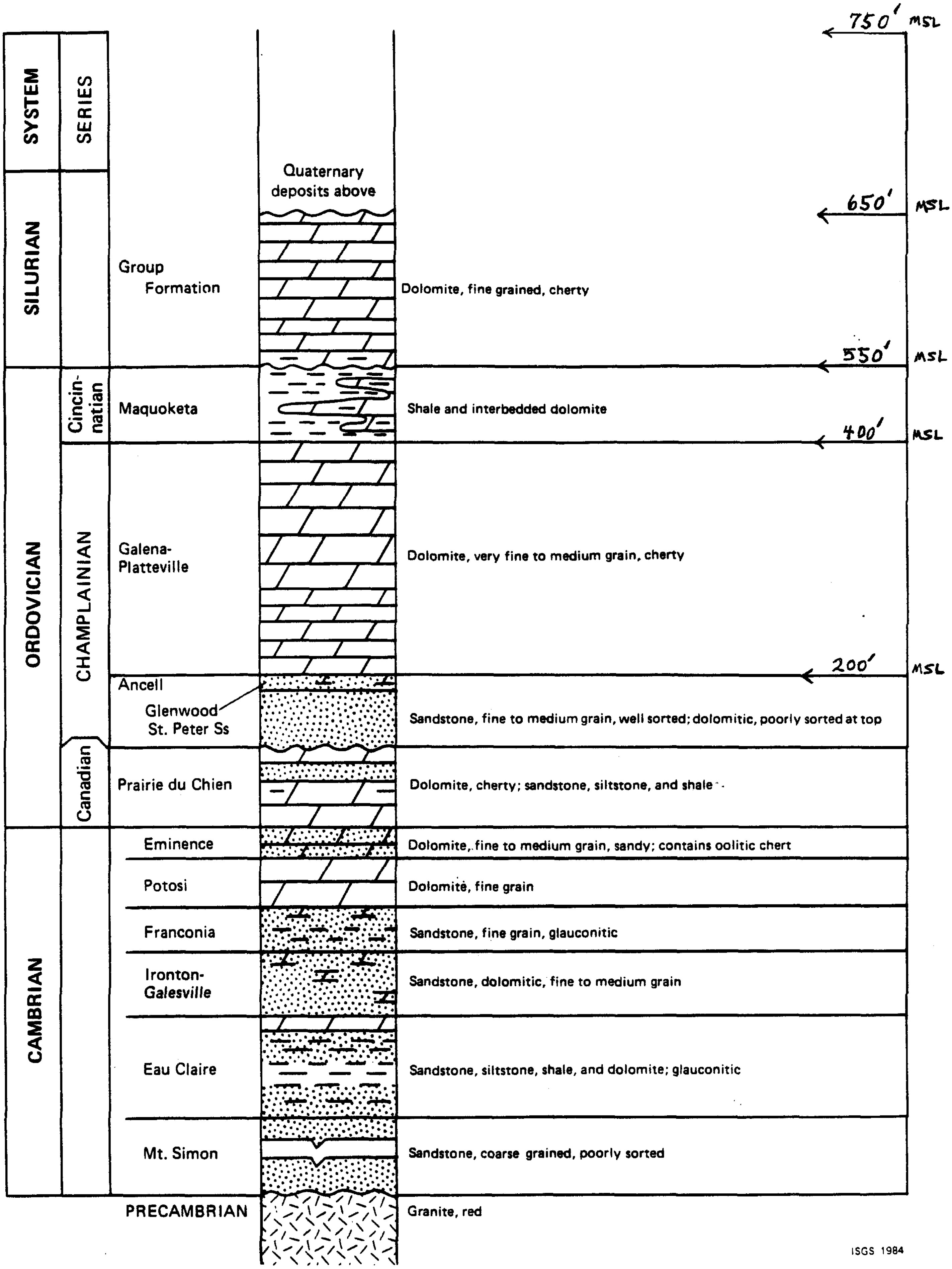

Figure 1. Stratigraphic column of bedrock units in northern Illinois.